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## DIRECTORY SERVER SYSTEM FOR STORING 5 PAST-HISTORY INFORMATION

### BACKGROUND OF THE INVENTION

10 The present invention relates to a directory server system for storing past-history informations, and more particularly to a directory server system for an extension of service interface to users.

15 The conventional directory server system enables the users to avail informations about present or current states of users and equipments registered on the server. Namely, the conventional directory server system stores only the informations about present or current states of users and equipments registered on the server. The users is unable to obtain the past-history about the states of the registered users or equipments and also unable to confirm the exact renewal dates.

20 In the above circumstances, it had been required to develop a novel directory server system free from the above problem.

### SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a

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novel directory server system free from the above problems.

It is a further object of the present invention to provide a novel directory server system for storing past-history about the states of the registered users or equipments.

5 It is a still further object of the present invention to provide a novel directory server system for storing the exact renewal dates of the states.

10 It is yet a further object of the present invention to provide a novel directory server system for providing renewed informations about past-history of the states of the registered users or equipments.

15 The present invention provides a directory server system comprising : a directory server for storing an attribute of an entry ; an entity monitor being connected to the directory server for monitoring an entity, so that if a change in a state of the entity appears, then the entity monitor instructs the directory server to renew an attribute of a corresponding entry to the entity ; and a directory renewal history storage device being connected to the directory server for storing a renewed attribute of the entry as attribute renewal history informations.

20 The above and other objects, features and advantages of the present invention will be apparent from the following descriptions.

## BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments according to the present invention will be

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described in detail with reference to the accompanying drawings.

FIG. 1 is a block diagram illustrative of a structure of a novel directory server system in a first embodiment in accordance with the present invention.

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## DISCLOSURE OF THE INVENTION

The present invention provides a directory server system comprising : a directory server for storing an attribute of an entry ; an entity  
10 monitor being connected to the directory server for monitoring an entity, so that if a change in a state of the entity appears, then the entity monitor instructs the directory server to renew an attribute of a corresponding entry to the entity ; and a directory renewal history storage device being  
15 connected to the directory server for storing a renewed attribute of the entry as attribute renewal history informations.

It is preferable to further comprise a time-correspondent directory server connected to both the directory server and the directory  
renewal history storage device for confirming an existence of a target entry on the directory server, so that if the existence of the target entry on the  
20 directory server could be confirmed, then the time-correspondent directory server obtains the attribute renewal history informations from the directory renewal history storage device.

It is preferable to further more comprise a directory purging entry storage device being connected to the directory server, the directory

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renewal history storage device and the time-correspondent directory server for storing an entry corresponding to an absent entity which has become absent, whilst the entry becomes absent on the directory server.

It is moreover preferable that if the entity becomes absent, then  
5 the attribute renewal history informations of a corresponding entry to the absent entity are deleted from the directory renewal history storage device, and in place the directory purging entry storage device stores the attribute renewal history informations.

It is preferable to further moreover comprise a time-  
10 correspondent directory client connected to the time-correspondent directory server for sending the time-correspondent directory server a request for obtaining attribute history informations at a past time of an entry from the time-correspondent directory server in order to refer the attribute history informations at the past time.

It is also preferable that if the request from the time-  
15 correspondent directory client is free of any access right, then the time-correspondent directory server rejects the request and sends the time-correspondent directory client a notice to the effect that the request is illegal.

It is preferable to further comprise a time-correspondent  
20 directory client connected to the time-correspondent directory server for sending the time-correspondent directory server a request for obtaining attribute history informations during a past time period of an entry from the time-correspondent directory server in order to refer the attribute history

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informations during the past time period.

It is further more preferable that if the request from the time-  
correspondent directory client is free of any access right, then the time-  
correspondent directory server rejects the request and sends the time-  
5 correspondent directory client a notice to the effect that the request is  
illegal.

It is also preferable that the directory renewal history storage  
device also stores renewal time and date together with the renewed attribute  
of the entry as attribute renewal history informations.

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## PREFERRED EMBODIMENT

A first embodiment according to the present invention will be  
described in detail with reference to the drawings. FIG. 1 is a block  
15 diagram illustrative of a structure of a novel directory server system in a  
first embodiment in accordance with the present invention. The novel  
directory server system has the following structures. A directory server 1 is  
provided for storing attribute informations of entries. An entity status  
monitor 2 is connected to the directory server 1 for monitoring the change  
20 of states of the entity 7 which corresponds to registered users or  
equipments, so that the entity status monitor 2 renews the attribute  
informations of the entries stored in the directory server 1 upon change of  
the states of the entity 7. A directory renewal-history storage device 3 is  
connected to the directory server 1 for storing renewal dates and renewed

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contents of the directory server 1. A directory purging entry storage device 6 is connected to both the directory server 1 and the directory renewal-history storage device 3 for storing all of the attribute renewal past-history informations for an absent entry on the directory server 1, wherein the  
5 absent entry corresponds to the past-entity 7 which is currently absent. A time-correspondent directory server 4 is connected to the directory server 1, the directory renewal-history storage device 3 and the directory purging entry storage device 6 for generating an attribute renewal history information. A time-correspondent directory client 5 is connected to the  
10 time-correspondent directory server 4 for obtaining the attribute renewal history information from the time-correspondent directory client 5 and displaying the same.

Operations of the above novel directory server system will be described. The entity status monitor 2 continuously or periodically  
15 monitors the service state of the entity 7. If any change in the service state of the entity 7 appears, then the attribute of the entry corresponding to the entity 7 is renewed by the directory server 1, wherein the entry is stored in the directory server 1. The directory server 1 sends the renewal date and the renewed contents to the directory renewal-history storage device 3, so that  
20 the directory renewal-history storage device 3 stores the renewal date and the renewed contents.

The time-correspondent directory client 5 sends the time-correspondent directory server 4 a request for the past-state of the entry on the director server 1, so that the time-correspondent directory server 4

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couples the information from the directory server 1 to the information from the directory renewal-history storage device 3 for sending only the requested information about the past-state of the entry, whereby the time-correspondent directory client 5 receives the past-state of the entry from the time-correspondent directory server 4.

The following descriptions will focus on the detailed operations of the above directory sever system. The entity status monitor 2 receives the information about change of the state of the entity 7. The entity status monitor 2 instructs the directory server 1 to renew the attribute information of the entry corresponding to the entity 7, wherein the entry exists on the directory server 1. The renewed information on the directory server 1 is sent to the directory renewal-history storage device 3 and stored in the directory renewal-history storage device 3.

If the entity 7 becomes absent, then the entity status monitor 2 instructs the directory server 1 to send the directory purging entry storage device 6 the entry corresponding to the entity 7, whereby the entry is deleted from the directory server 1, so that the directory purging entry storage device 6 serves the entry. Further, the directory purging entry storage device 6 obtains all attribute renewal history informations of the target entry from the directory renewal-history storage device 3 in order to store the all attribute renewal history informations, wherein the history informations of the target entry are deleted from the directory renewal-history storage device 3.

The time-correspondent directory client 5 sends the time-

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correspondent directory server 4 a request for the information about a past-state at a past-time of the entry on the directory server 1 or the information about change of the past-state in a past-time period. The time-correspondent directory server 4 receives this request from the time-correspondent directory client 5, so that the time-correspondent directory server 4 confirms whether or not the target entry currently exists in the informations on the directory server 1. If the target entry exists, then the time-correspondent directory server 4 obtains the attribute renewal history information from the directory renewal-history storage device 3. If the target entry does not exist currently in the informations on the directory server 1, then the time-correspondent directory server 4 confirms whether or not the target entry exists in the directory purging entry storage device 6. If the target entry exists, then the time-correspondent directory server 4 obtains information of the purging entry from the directory purging entry storage device 6. After the time-correspondent directory server 4 obtained the information, then the time-correspondent directory server 4 sends the time-correspondent directory client 5 the requested time-correspondent information.

If it is necessary to prepare the entry on the directory server 1 in correspondence with the entity 7 for the supervisor for supervising the change of the state or for the equipment, then the manager of the director server 1 sets the entity status monitor 2 so that the entity status monitor 2 monitors the state change of the entity 7. The entry preparing information on the directory server 1 is stored as an initial state information of the



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entity 7 on the directory renewal-history storage device 3, wherein access rights are set to the individual entries of the directory renewal-history storage device 3.

5 If the state change appears on the entity 7, then the entity status monitor 2 obtains the state change information and instructs the directory server 1 to renew the attribute information of the entry corresponding to the entity 7, wherein the entry exists on the directory server 1, so that the attribute renewal information of the entry is stored in the directory renewal-history storage device 3.

10 If it is necessary to delete the entry on the directory server 1 in correspondence with the entity 7 for the supervisor for supervising the state change or the equipment, then the manager for the directory server 1 releases the entity status monitor 2 from monitoring the state change information of the entity 7. The information of the entry deletion from the  
15 directory server 1 is stored in the directory renewal-history storage device 3 and concurrently the directory renewal-history storage device 3 sends the directory purging entry storage device 6 all of the attribute renewal history informations of the target entry. The access right to the history information in the directory renewal-history storage device 3 is succeeded to the  
20 purging entry on the directory purging entry storage device 6.

If the directory service user wishes to know a past-state at a past-time of the entry on the directory server 1, then the directory service user operates the time-correspondent directory client 5 to send the time-correspondent directory server 4 a request for obtaining the information

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about the past-state by utilizing a Search Request of LDAP provided under the following RFC2251 of IETF. An "X-search At Time" attribute filter is additionally specified in response to Attribute value Assertion under Filter Equality Match Rule in order to designate the date and time of the search  
5 target of the search target entry, wherein "X-search At Time" accords to the syntax (1.3.6.1.4.1.1466.115.121.1.24 DESC 'Generalized Time').

The time-correspondent directory server 4 removes the "X-search At Time" from the received Search Request Filter to obtain the Search Request of LDAP, so that the time-correspondent directory server 4 utilizes  
10 the Search Request of LDAP in order to confirm the existence of the entry in the directory server 1. If the existence of the entry could be confirmed, then the time-correspondent directory server 4 obtains the attribute renewal history information of the entry from the directory renewal-history storage device 3, so that the time-correspondent directory server 4 form attribute  
15 informations at a time when the request is issued, in order to respond to the time-correspondent directory client 5. If the directory service user has no access right to the attribute renewal history informations of the entry, then the time-correspondent directory server 4 rejects the request and sends the time-correspondent directory client 5 an error response which indicates that  
20 the request is illegal.

If the time-correspondent directory server 4 could not confirm the presence of the target entry on the directory server 1, then the time-correspondent directory server 4 attempts to confirm the presence of the target entry on the directory purging entry storage device 6 in order to

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confirm whether or not the target entry has already been deleted from the directory server 1. If the target entry does not exist on the directory purging entry storage device 6 or if the directory service user has no access right, then the time-correspondent directory server 4 rejects the request and sends  
5 the time-correspondent directory client 5 an error response which indicates that the request is illegal. If the target entry is present on the directory server 1, then the time-correspondent directory server 4 obtains the attribute renewal history information of this entry, so that the time-correspondent directory server 4 form attribute informations at a time when  
10 the request is issued, in order to respond to the time-correspondent directory client 5. If the entry has been deleted at the time when the request was issued, then the time-correspondent directory server 4 sends the time-correspondent directory client 5 both a notice to the effect that the entry has already been deleted and a final state of the entry.

15 If the directory service user wishes to know a past state history during a past-time period of the entry on the directory server 1, then the directory service user operates the time-correspondent directory client 5 to send the time-correspondent directory server 4 a request for obtaining the information about the past state history by utilizing a Search Request of  
20 LADP provided under the following RFC2251 of IETF. Both an "X-search Start Time" attribute filter and an "X-search End Time" attribute filter are additionally specified in response to Attribute value Assertion under Filter Equality Match Rule in order to designate both the start date and time of starting the search target of the search target entry and the end date and

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time of ending the search target of the search target entry, wherein "X-search At Time" and "X-search End Time" accord to the syntax (1.3.6.1.4.1.1466.115.121.1.24 DESC 'Generalized Time').

The time-correspondent directory server 4 removes the "X-search  
5 Start Time" and "X-search End Time" from the received Search Request  
Filter to obtain the Search Request of LDAP, so that the time-correspondent  
directory server 4 utilizes the Search Request of LDAP in order to confirm  
the existence of the entry in the directory server 1. If the existence of the  
entry could be confirmed, then the time-correspondent directory server 4  
10 obtains the attribute renewal history information of the entry from the  
directory renewal-history storage device 3, so that the time-correspondent  
directory server 4 form attribute informations at the started time of the  
requested time period and a post attribute renewal history information, in  
order to respond to the time-correspondent directory client 5. If the  
15 directory service user has no access right to the attribute renewal history  
informations of the entry, then the time-correspondent directory server 4  
rejects the request and sends the time-correspondent directory client 5 an  
error response which indicates that the request is illegal.

If the time-correspondent directory server 4 could not confirm  
20 the presence of the target entry on the directory server 1, then the time-  
correspondent directory server 4 attempts to confirm the presence of the  
target entry on the directory purging entry storage device 6 in order to  
confirm whether or not the target entry has already been deleted from the  
directory server 1. If the target entry does not exist on the directory purging

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entry storage device 6 or if the directory service user has no access right, then the time-correspondent directory server 4 rejects the request and sends the time-correspondent directory client 5 an error response which indicates that the request is illegal. If the target entry is present on the directory server 1, then the time-correspondent directory server 4 obtains the attribute renewal history information of this entry, so that the time-correspondent directory server 4 form attribute informations of the requested time period and the attribute renewal history information, in order to respond to the time-correspondent directory client 5. If the entry has been deleted before the requested time period, then the time-correspondent directory server 4 sends the time-correspondent directory client 5 both a notice to the effect that the entry has already been deleted and a final state of the entry.

Accordingly, the above described novel directory server system enables the user to operate the time-correspondent directory client to refer the attribute renewal history information on the renewed directory server 1, thereby obtaining the past-entry on the director server 1 and the informations about the status changes of the person or equipment which corresponds to the entry.

Whereas modifications of the present invention will be apparent to a person having ordinary skill in the art, to which the invention pertains, it is to be understood that embodiments as shown and described by way of illustrations are by no means intended to be considered in a limiting sense. Accordingly, it is to be intended to cover by claims all modifications which

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fall within the spirit and scope of the present invention.